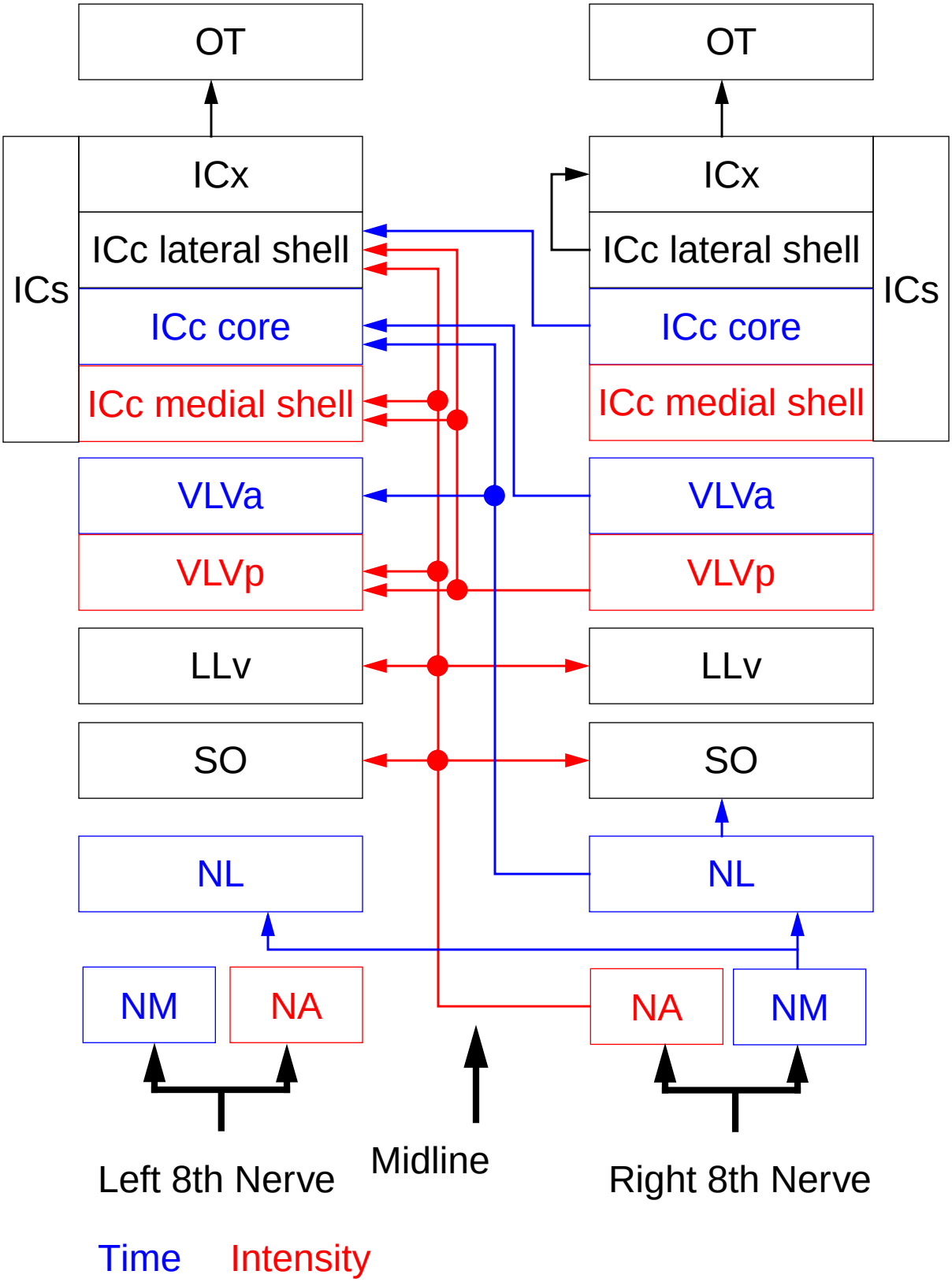
Passive Sound Localization in the Barn Owl

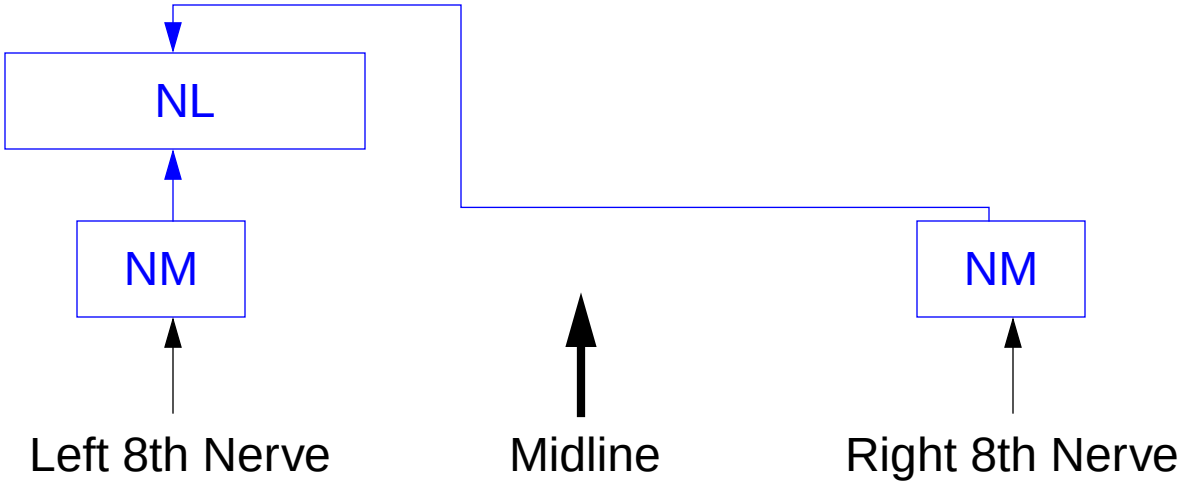
Clay Spence and John Pearson

Sarnoff Corporation
CN5300
Princeton, NJ 08543-5300
{cspence, jpearson}@sarnoff.com

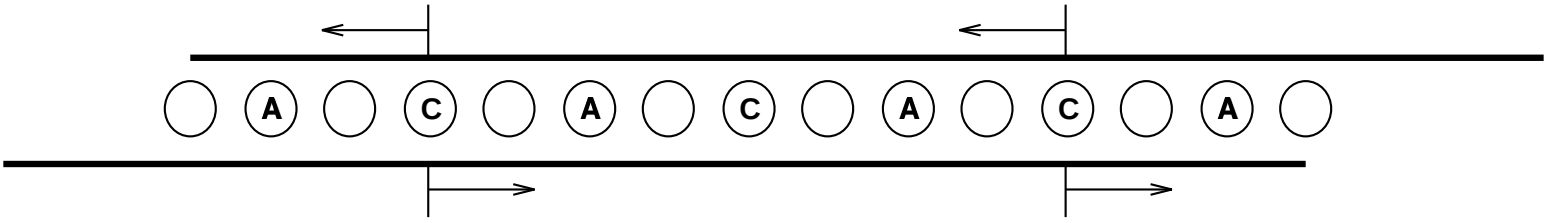
Block Diagram of the Owl's Auditory Localization System



Timing (ITD) Pathway



Inside NL:



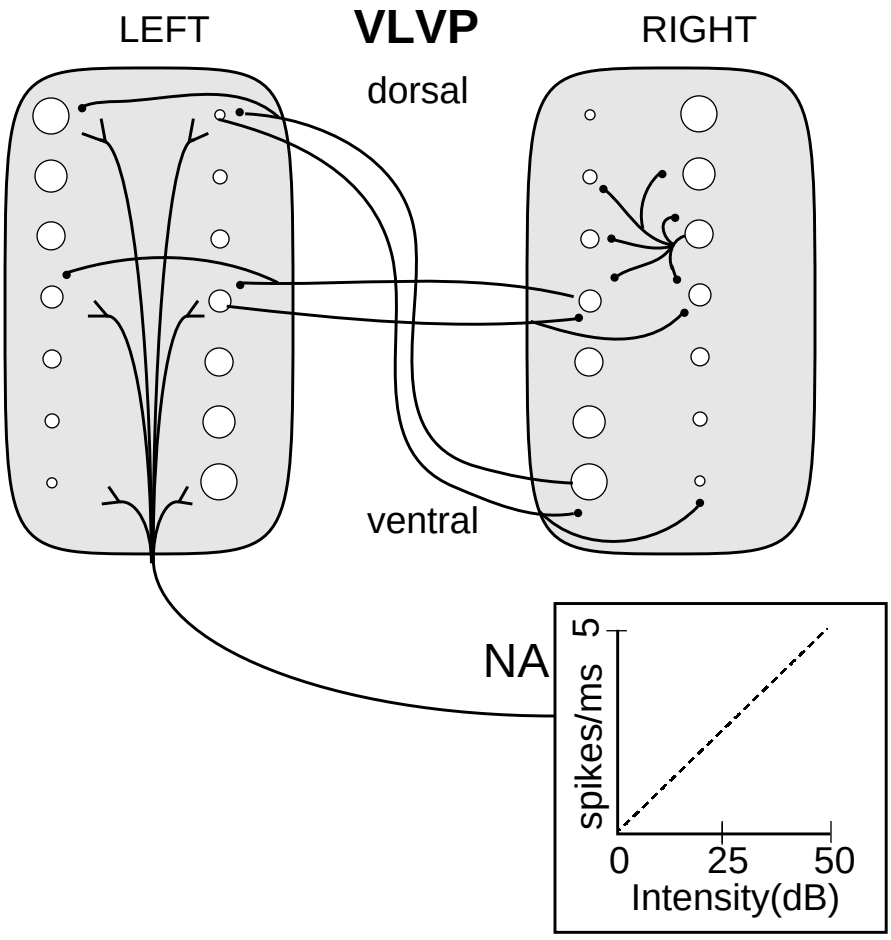
NM neurons pull out timing information (phase lock).

NM axons act as delay lines (Jeffress, 1948).

NL Neurons act as coincidence detectors (?).

Map of ITD (interaural time delay) vs. frequency.

Intensity (IID) pathway



NA neurons pull out sound intensity, insensitive to phase.

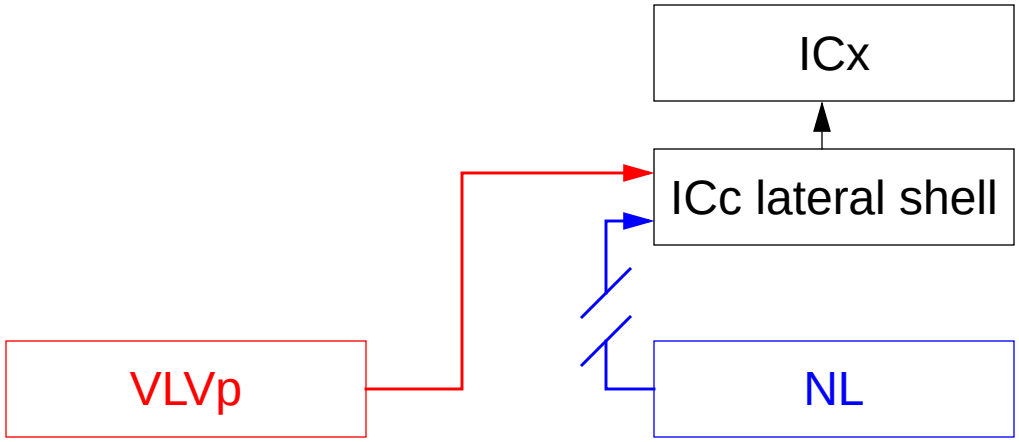
NA excites contralateral VLVp.

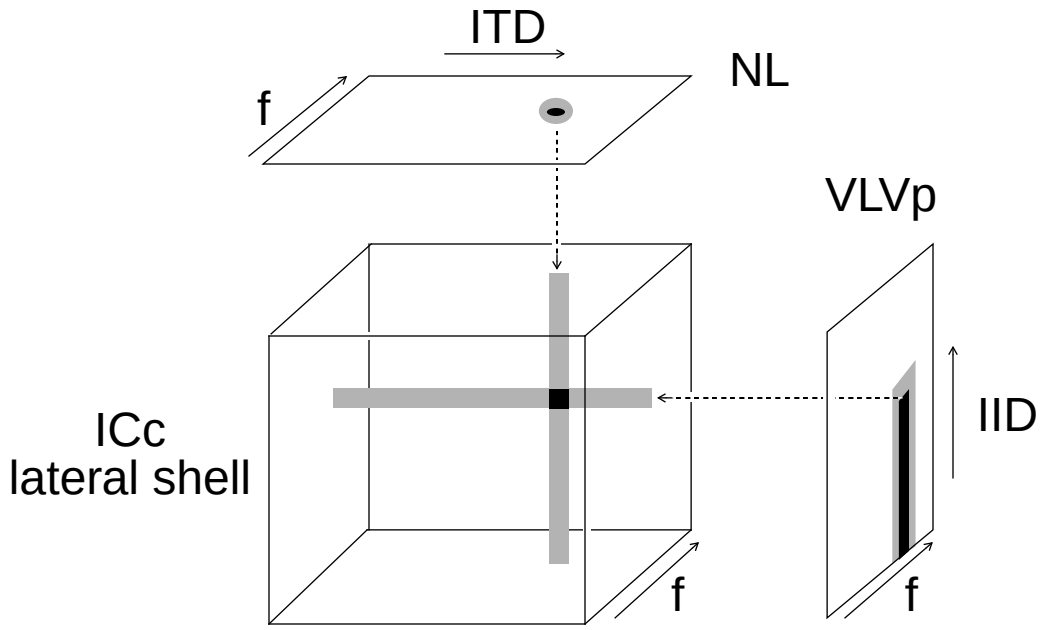
Two VLVps inhibit each other;
compete.

Inhibition varies with position.

Map of interaural intensity difference (IID) vs. frequency.

Combining ITD and IID to make a Space Map





Model: Combine IID and ITD *before* summing frequencies, works with multiple sources.

ICc lateral shell resembles this, more complex.

Other interesting problems in the owl

- Visual/auditory fusion in the optic tectum (OT); adaptive alignment ICx.
- ITD disambiguation (combine frequencies).
- Details of VLVp connections and dynamics.
- IID tuning mechanism in ICc lateral shell.
- Dependence on average binaural intensity in OT.

Problems we have yet to work on:

- Motion sensitivity in IC.
- Adaptation in VLVp.